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ABSTRACT

This paper explores a technique, simulation gaming, used by management and by planning educators in several fields for approaching some of the elements of human relations matters and concepts. It seeks to survey the development of this method by tracing the development of the simulation gaming technique in symbolic simulation. Some of its utilities and liabilities are then identified. Simulation game topology is discussed, after which the educational and research potential of this gaming method is examined together with simulation game artifacts, cautions, and remedies for educational and research applications. Applications of the technique to health planning and consumer health education objectives generally are suggested, and a health maintenance game structure is outlined. The game model focuses on problem areas most specifically relevant for those in the comprehensive health planning sphere, rather than limited to health planning education applications per se. References conclude the work. (BL)

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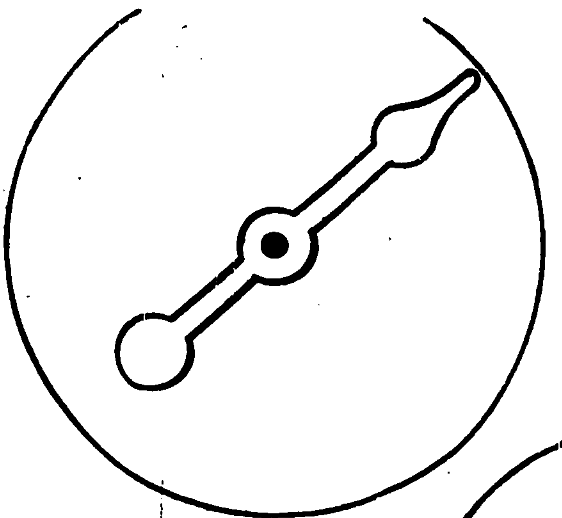

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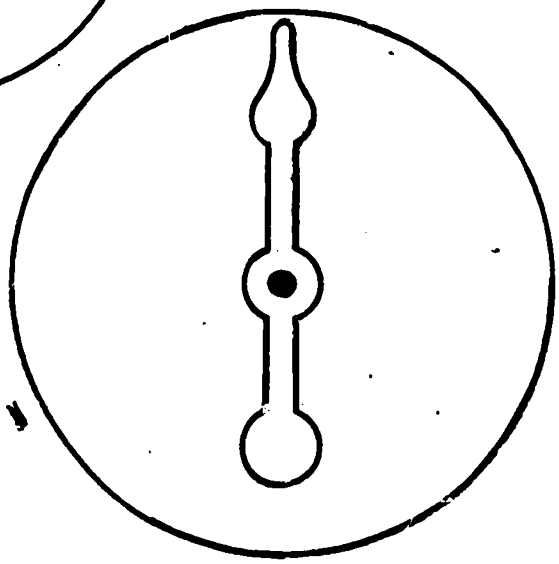

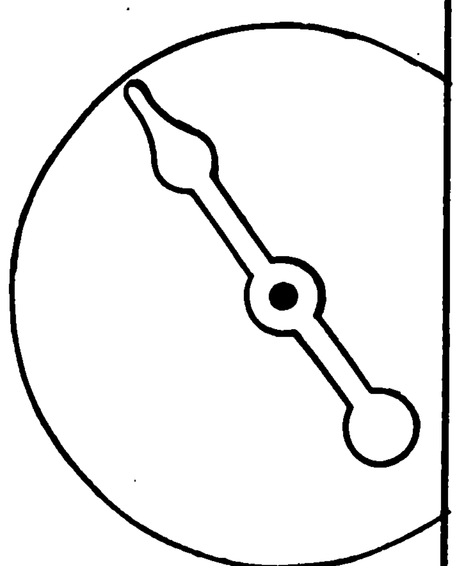

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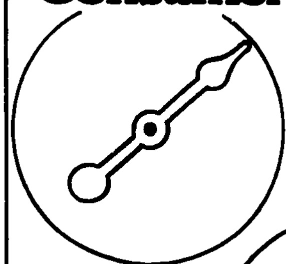

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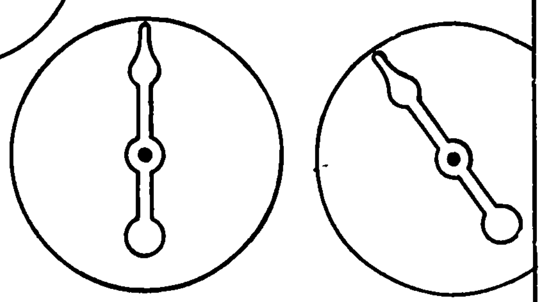

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ABSTRACT

Prospects for simulation gaming in health planning and consumer health education are examined first by tracing the development of the simulation gaming technique in symbolic simulation. Simulation game topology is then discussed, after which the educational and research potential of this gaming method are examined. Simulation game artifacts, caveats, and remedies for these appear in the section following. Health applications of the technique are discussed, and a health maintenance game structure is outlined as an example of one prospective simulation game model appropriate for certain health planning and consumer health education purposes.

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PREFACE

The tasks of comprehensive health planning might well have been greatly diminished had Congress chosen to delimit the undertaking by not incorporating certain of the present provisions of P.L. 89-749. It might, for example, have deleted from the Act requirements for consumer participation on boards of comprehensive health planning agencies. In its wisdom Congress chose the path of greater resistance, thus conferring upon comprehensive health planning (CHP) agencies and training programs additional responsibilities variously unfamiliar to traditional health planners.

As a result, a premium has been placed on the development of especially effective instruments and programs for health planning and consumer health education. This emphasis reflects recognition of the simple but compelling necessity for developing solid working relationships between CHP agency board and staff members, between professional and nonprofessional CHP board members, between CHP trainees and instructors; and for advancing consumer health education in general.

These educational instruments and programs are presently being developed to fulfill the needs of the above individuals for insights as well as available "hard" information on matters such as optimal allocation of resources for health purposes, and prediction of health manpower and service need trends. But the educational responsibility does not end here.

At least equally important to participants in CHP efforts will be insights, and occasionally understandings, of concepts more traditionally treated as human relations matters. For example: the behavior of vested professional and nonprofessional interests; negotiation techniques; goal deflection tendencies; development of value consensus; the operation of exchange processes in human behavioral transactions. Mention of "hard" information in the context of this latter set of concepts is intentionally deleted, since it is here that such data are especially difficult to discover.

This paper explores one of the more potent techniques used by management and by planning educators in other fields (e.g., business administration, urban planning) for approaching some of the elements in this second group of concepts (the human relations matters). Health applications of the technique--simulation gaming--have never been adequately considered. This essay seeks to survey the development of this method, to identify some of its utilities and liabilities, and to suggest applications to health planning and consumer health education objectives generally.

It develops, in addition, a basis for an adaptive health maintenance game.

The material herein is organized and presented from the perspective of problems presented health educators. Since the power that simulation gaming may bring to bear upon the tasks facing these educators will likely not be limited to health planning education applications *per se*, this essay attempts to avoid hyperspecialization with regard to its treatment of this intrinsically flexible technique by covering its prospects for use in public health generally. The game structure outlined, however, focuses on problem areas more specifically relevant for actors in the comprehensive health planning sphere.

CONTENTS

I. INTRODUCTION: SIMULATION GAMES AND SOME CLASSIC PROBLEMS IN CONSUMER HEALTH EDUCATION

> "Simulation is as old as man. . . . Indeed, it might be argued that, to the extent that man's uniqueness in nature derives from his ability to order, abstract, and generalize from his experience, the ability to simulate is an essential defining characteristic of the species."
> (Berger *et al*/1970:411)

> "The fascination of games is a curious matter. It must arise in part from the arbitrary setting aside of the vaguely defined but complex and deadly serious rules which govern daily life, and substitution of a set of explicit and simple rules whose consequences vanish when the game is over."
> (Coleman/1968a:7)

A recent inventory of simulation games shows nearly one thousand entries. (Zuckerman and Horn/1970) Only a handful of these treat health and health-related matters. Yet the justifications given for their development and use sound reminiscent of classic arguments of health educators for their own efforts at educational innovation. "The aim of health education," a World Health Organization document states, "is to help people achieve health by their own actions and efforts." (W.H.O./1954:4; emphasis added)

The desired personal initiative is frequently difficult to develop. Part of the problem is that health "is but one of the elements in the general welfare of the people, and health education is only one of the factors in improving health and social conditions." (W.H.O./1954:4-5) Health improvement, then, is not necessarily foremost in the minds of lay persons. We may therefore anticipate some difficulty in motivating changes in human health behavior. Similar motivation problems have encouraged innovative educators in other fields to explore the simulation game medium, and many have observed that "games have an attraction such that people play as if their lives depended upon the outcome, even when they do not." (Frank Knight, quoted in Boocock/1968:62-3)

Health education efforts are further hindered by the time separating health-benefitting measures from health benefits. (W.H.O./1954:11) This problem is often labelled one of relevance of communications to recipients, which quality may suffer when the latter feel far removed from situations described, or deny the applicability of information to themselves, or otherwise exhibit selective exposure to, selective perception and selective retention of communications. (Young/1967) One aspect of simulation games that has served to reduce the impact of the cause-effect separation, at least in non-health areas, is the ease of compressing the time frame of events. Players are able, through this condensation, to see quickly the outcomes associated with their game decisions.

Game designers assert further that their technique provides recipients with an opportunity to learn actively, by contrast with more common unidirectional (and passive) approaches. Again there are indications of a similarity in interests to those of health educators:

> "<Didactic> methods (which include lectures, films, leaflets, posters, radio, television, advertisements, and newspaper articles) assume that the learner is a more or less empty vessel, into which information is poured, and that he will then integrate, interpret, reproduce, or act upon the information at some later date."
> (W.H.O./1954:21; parentheses in text)

There is clear recognition in current health literature that "learning is an active process . . . most likely to take place when the individual actively seeks to acquire insights and understandings for himself." (Knutson/1965:409) Involvement, though, is certainly not the singular end sought. We seek instead its effects achievable on commmunications impact and understanding, and on behavior change. (Young/1967:10) Since didactic health education methods have not differed appreciably from those of educational didactic in general, it comes as little surprise that a recent survey of health education practice concludes that "much of what is included in health education seems to be in <the> low-involvement realm." (Young/1967:10)

In the next section the origins of simulation gaming in generalized symbolic simulation are traced. Most of Section II treats simulation modeling, as distinguished from the specialized offshoot, simulation gaming. Throughout this paper the term "simulation" refers to the universe of symbolic models, while "simulation gaming" refers to one class of models. Where simulation applications are noted it is implicit here that corresponding game-format applications are suggested.

II. SIMULATION

WHAT IT IS WE MEAN WHEN WE SAY SIMULATION

Interest in symbolic simulation--the realization of a "dynamic representation . . . by building a model and moving it through time" (William Arthur, cited in Kennedy/1967:8)--has grown considerably since its introduction as a technique for better predicting the utility of different armament configurations during WWII. Increasingly accessible computing facilities have potentiated developments in this area, adding new power and efficiency to the method.

Utilization of the technique is indicated where problems are posed for solution in which there are a high number of interacting variables; where mathematical solutions would be intractible; where random variables are involved; where real-life experimentation would be unethical or unfeasible or prohibitively expensive; where inputs are not certain; where details on the interaction of variables are not clear; or where the relative significance of one or more systems variables is not known. (Kennedy/1967) In the health sector, simulation is additionally suggested for certain situations where "the costs of premature, non-objective, or unfeasible decisions can be very great." (Wilson et al/1969:716)

Current interest among educators in this technique has been attributed to a widespread dissatisfaction with traditional teaching methods, to increasing interest in multidisciplinary efforts for attacking complex problems, to alleged interest in broadening the base of community decision-making, and to greater concern for developing sociological theories to predict human interactions, in complex environments, over time. Considerations of safety, as well as visibility and reproducibility of results, have also bec advanced as contributing to the popularity of simulation. (Raser/1969)

Typically, a simulation model designer identifies a system and its environment, and then attempts to isolate variables crucial to the systems behavior of interest.

> "Once the variables that have been selected are given values within the simulation and the relations among the variables are specified, the model is allowed to operate. It may operate through the interaction of people who play roles within the model; or it may operate on a computer. The rules given to the human participants in the simulation or <specified in> the computer program represent the premises of the model. Its operation produces the implications."
> (Sidney Verba, quoted in Raser/1969:10)

One characteristic of symbolic (by contrast with physical) simulations has been found particularly well-suited to computerization.

"In <developing a> simulation, the investigator must masochistically introduce stochastic elements to more faithfully reproduce the characteristics of the real world. . . . In simulated experimentation the stochastic variability . . . is deliberately and explicitly placed there by the <model> constructor."
(Conway, quoted in Schechter/1971:83)

We will consider shortly the disadvantages posed in certain applications by computer simulation in contradistinction to manual simulation.

UTILITY OF SIMULATION IN PLANNING EDUCATION

One educational simulation application area receiving relatively great attention has been that of planning education. While planners are quick to point out that "there is no surrogate for the world itself," they suggest that future involvement-style courses may not necessarily place students in real populations.

"Field work is only one of a number of techniques for bringing the complexity of reality to the classroom. Games and other simulations, as well as the study of carefully constructed cases, can provide highly efficient substitutes and will probably come to play an increasingly important role in planning education."
(Doebele/1970:278)

Problems faced in field work education projects include the following:

"The real world operates on a different time scale. . . . Field experience poses problems of competence . . . . Field services raise problems of conflicts of objectives <clients' vs. clinicians'> and ultimate control . . . . involve a pull toward politicization . . . . <and> involve real dangers of cooptation and manipulation." (Doebele/1970:274)

A recent health education forecast similarly cites an increased (and welcome) emphasis on involvement style instruction, but does not consider the power simulations and simulation games may provide students, while they can (but need not of necessity) serve to diminish manipulation and perceived manipulation of real communities. "We can anticipate," the forecast states, "that graduate and undergraduate preparation in health education will increasingly discover the wisdom and appropriateness of problem-centered education involving live communities." (Levin/1969:1986)

The two educational styles are by no means mutually exclusive. Simulation techniques, while not operating on live communities, may enhance considerably the educational value of involvement programs. An integration of field work with simulation modelling would seem especially valuable where models are used in such manner as to induce students working in live communities to identify patterns in the system under observation as well as to assess determinants of systems behavior.

UTILITY OF SIMULATION IN CONSUMER EDUCATION

The promise of simulation work in reversing the current "castration of the student as an effective actor in society" (Doebele/1970:273), however, is only a portion of its potential in planning education. The formal planning student need not be the only beneficiary. Lay persons might also be enlisted.

> "A simulation can be the basis for local residents to learn the expectable outcomes of various alternatives for action which might occur to them. It could for example, be developed as a sort of community game. It would have the virtues of realism and complexity, yet with a sense of control, and the kind of fun which goes with genuine involvement."
> (Wiggins/1966:220)

We will discuss later the implications of this style of "genuine involvement," but may suggest here a distinct advantage to the inclusion of community people in this sort of activity. The jist of the advantage is that lay people may better grasp, through their own participation in simulation experiments, the nature of the difficulties facing planners, and will better understand the recent yet classic understatement that "success in planning is not inevitable" (George Bugbee, quoted in J.J. May/1971: fwd). If despite the best of intentions there occur planning errors, it would seem valuable for those affected to understand the difficulties involved.

Of course, simulation can, like any other technique, be used to procrastinate or deceive, and may justifiably become suspect if lay experience demonstrates these to be its principal uses in community involvement efforts. Should the presence of a simulation model be taken for an automatic improvement in health care there is little question that unfair expectations will be raised, although in many instances past community experience with raised expectations may suggest dismissing the potential value of this or any innovation outright.

Visibility of the changes in system outputs--occurring in response to variation of inputs, or internal parameter changes--can be greater for simulation models than is true of other methods for understanding and predicting systems behavior. However, that visibility may still leave a great deal to be desired. Lay persons can perhaps never get the sense for the interrelatedness of systems variables, and of the logic used in their selection, that the <u>designer</u> may have. All they see are inputs, outputs, and (if accessible) controllable variables. The situation is likely to be especially bleak in those instances where extensive computer assistance induces a designer to make his model increasingly complex, in hopes of improving its validity. The danger here is that "the model may become almost as complex as the real world, and, therfore, the model may become almost as difficult to understand." (R. M. Cyert, quoted in Schechter/

1971:74)

SOME SIMULATIONS ARE BEST DONE ON A COMPUTER AND SOME ARE NOT

Shubik (1968:639) lists several factors which merit consideration in determining whether computerized or noncomputerized games are designed:

1. The costs and availability of computers and trained personnel
2. The importance of computational error in the game
3. Administration and paper-handling costs
4. The importance of time delays
5. Displays and input-output instrumentation
6. Need to automate analysis
7. Importance of parameter control
8. Mobility

Another comparison centers on the mode of learning encouraged by computer simulations, which may differ markedly from that of simulations performed by hand and other nonmechanical methods (e.g., referees, role-playing). "Computer-simulation fosters deductive learning of the model and its relationships," explains one simulation gaming guide, "while manual simulation promotes inductive learning of the model or system." (Klietsch and Wiegman/1969:6) The relative visibility of the model in each case plays an important part in the differentiation of learning modes.

There is clearly a strong case to be made for manual simulation as a learning aid where complex systems would not otherwise be understandable. Simulation game designers have developed means whereby the computational tedium that could result from leaving the computer is replaced principally by the inclusion of humans in the simulated environment. While computer simulations can be designed or adapted to form games, there are other distinct advantages to designing computer-free models. One is the present inaccessibility of most lay people to computers. Another is the improvement, in certain respects, of the flexibility afforded untrained users made possible through manual simulations. We will consider simulation gaming, a special application of simulation modelling, in the next and following sections.

III. SIMULATION GAME TOPOLOGY

An early survey of business games classified simulation games on five points: generality, interaction, determinism, method of calculating results, and participation structure. (Greenlaw et al/1962) We will consider first the dimensions of generality, interaction, and determinism.

GENERALITY

The extent of situation specificity built into a game determines its generality. Some maintain great generality (e.g., Gamson's societal simulation, SIMSOC). More recently there have been developed increasing numbers of situation-specific games. An example is "The Fate of Our Food" (1969):

> "Each player attempts to be the first one to get three swallows of food (boluses) from the mouth through the digestive tract . . . . The players make decisions, based on the cards they draw (enzymes, saliva, and muscle strokes), as to how far the boluses they are directing can be advanced through the digestive system."
> (Zuckerman and Horn/1970:230)

INTERACTION

The dimension of player interaction (competitive to cooperative) is not as intuitively straightforward. Few simulation games operate at either end of the interaction continuum. Many are intended to give players and/or game administrators a feel for behavioral exchange processes operative in real-life but more readily discerned in semi-cooperative game environments. It is the bargaining of intangibles--like acceptance, autonomy, and deference--which is so important yet little understood in real life (at least by many player populations of interest here) that is frequently facilitated by appropriate game structures. (Coleman/1968c)

Game rules play the most significant part in determining player interaction characteristics. Coleman (1968c) categorizes these rules as: environmental response rules, procedural rules, behavior constraining rules, rules regarding goal specification, and police rules. In his treatment of interaction in simulation games, Schild (1968a:95) writes: "Rules . . . are a set of role definitions. They define for each player his goals, the resources with which he can pursue the goals and the activities which legitimately may be performed in this pursuit," and they determine inter-role relationships. As discussed in Section II, the premises on which the model is based manifest themselves in the game rules.

DETERMINISM

On the determinism (predictability of outcomes) dimension simulation games show wide variation. The significance of this game quality is described by Greenlaw <u>et al</u>

(1962:25):

> "A game model may become obvious to participants after a few periods of play unless chance elements are introduced as complicating factors . . . . <But> if operating success or failure is determined to too great an extreme by pure chance, it will be difficult, if not impossible, for participants to see any consistent relationship between their decisions and results, thus tending to create frustration, boredom, and lack of interest."

Chance components can, of course, serve as more than simply "complicating factors," for they may well operate to enhance the validity of the model where decisions represent those made under conditions of risk in real life.

CALCULATION OF RESULTS

Methods of determining game results also vary greatly. Some games rely on computers for generating complex and accurate game status reports. Less quantitatively sophisticated techniques are more often used, however, and a few designers have employed a combination of noncomputer methods for calculating intermediate results and computer methods after the game terminates. Results in some games are subjectively determined by game players, administrators, referees, or umpires; in others, more objectively by explicit environmental response rules.

"Satisfaction units" may be used for measuring goal achievement. In this instance games may specify, or leave to players, the procedure for converting objective achievements to subjective satisfaction units. (Coleman/1968c:39-40) Players may, in some games, choose a winner or winners using criteria entirely their own. Finally, certain games make no provision for a synthesis of intermediate results (a "winner" serves this function well). There may be no winner or formal outcomes measure. There may instead be a post-game discussion, as mentioned earlier, designed to catalyze further investigations by players into subject matter, as well as to serve a release function in instances where a game contributes to a heightening of player anxieties. The discussion may also serve to help integrate the game experience with that of real-life. It additionally provides an opportunity for identifying and evaluating game artifacts.

PARTICIPATION STRUCTURE

Game developers have to take several other design variables into consideration during simulation game construction. These include: the ease with which players can assess progress of opponents during the game; the degree to which probabilistically-determined events negate the value of strategy development; the amount of time between moves; the amount of information players are required to memorize during the game; the ease of learning the game rules. (Coleman/1968a)

Thought must be given, in addition, to the proper time for ending the game. Gamson suggests for SIMSOC that point where "enough is still unresolved to provide ammunition for a vigorous post-mortem about what would have happened and why," as opposed to ending at an action climax or after resolution of a crisis. (Gamson/1969a:10) He also suggests that "end-game effects," such as "end-of-the-world" behavior, be avoided by not giving players a clear idea of the exact time the game will end.

IV. SIMULATION GAMING FOR EDUCATIONAL PURPOSES

Simulation gaming has been described as a "combination of systems sciences with the dramatic arts" to effect a translation of an analytical model into a social drama. (Abt/1968:78) "The game," Abt explains, "combines elements of dramatic conflict, curiosity over the outcome of uncertain events and direct emotional expression through role playing." (1968:75)

Most simulation games have been designed primarily for teaching purposes, but more recently have been applied to research ends as well. Some were created for neither of these reasons but merely for private profit--Monopoly, for example--while others show variable emphasis on this game dimension. There are presently indications that there has developed a mystique about simulation gaming, attributed by some to the early involvement of RAND and similarly awesome and well-funded groups in this area. "There is something about money that lends a halo of credibility to even the most outrageous ideas," Davis (1970) suggests, "but when an idea has a germ of credibility to begin with, the effect of money on it is positively dazzling." We will consider the morphology of this "germ of credibility" in this and in following sections.

EDUCATIONAL STRENGTHS OF MANUAL SIMULATION GAMES

Included among the educational strengths of simulation games are:

1. Increased visability of systems
2. Fusion of systems sciences with dramatic arts
3. Discouragement of uncritical acceptance of model outputs
4. Reduced complexity of systems
5. Exploitation to good advantage of peer influences on learning
6. Motivation generated by problem-solving techniques (simulation gaming is one such technique)
7. Opportunity to test alternate strategies without real-life repercussions
8. Insights into social organization beyond classroom confines
9. Benefits to game designers from the practice of their art

In our discussion of the visibility of systems behavior, with respect to simulation models which operate on computers, we noted the threat to that visibility posed by "invisible" machine algorithms, by deeply nested subroutines about which lay observers know little. This situation is not conducive to communicating an appreciation for internal systems behavior. The basis for the predictable effects of the invisibility here is described by Knutson (1965:159): "What <man> does not perceive does not exist for him insofar as he personally is concerned. It makes no difference how the situation may be defined by other--even more competent--observers." Manual simulations constructed as games can be designed so as to increase model visibility markedly. The level of abstraction of the noncomputer model must of necessity be lower than that of its computer counterpart. Real people are incorporated in the simulation structure as variably flexible systems components.

A player in a well-designed simulation game is believed less easily tempted to "uncritical acceptance of analytical results" than his computer simulation counterpart (Raimer and Steger/1961:18). Indeed, he is encouraged to be critical not only of his own actions, and those of others participating within the simulated system, but of model constraints as well. The results are, furthermore, less likely to be expressible quantitatively in the noncomputer simulation, and may thus lack the face validity sometimes attending numerical results. There may even be substantial disagreement as to just what has resulted, depending on the rigidity of game structures provided for determining outcomes and evaluating player performance.

The movement from computer to manual simulation most often requires a substantial reduction in model complexity for it to be kept tractable for the intended audience. Extensive incremental calculations are ruled out; frequency of events must be decreased tremendously (but the time frame is still frequently compressed); opportunities increase for departing from the game-against-nature model (in which uncontrollable variables do not react against the assignment of values to controllables); and requisite simplification necessitates consideration of which variables and relationships are most crucial and should thus be preserved.

This emphasis on reduced complexity is paralleled in Coleman's summary game characterization. (1968b:63) "In short," he writes, "a game is a way of partitioning off a portion of action from the complex stream of life activities. It partitions off a set of players, a set of allowable actions, a segment of time, and establishes a framework within which the action takes place . . . . a minute social system."

The game environment is conducive to learning due, in part, to its ability to provide information for action to a collective audience, for treatment by group as well as individual processes. Knutson is eloquent in his description of peer influences on learning:

> "One who would influence the learnings of others must ever remember that man does not acquire and integrate new behavior in isolation. The love and affection of his intimates, the associations he holds dear, the sanctions he honors, the rules he obeys, the boundaries he respects, the punishment he fears--all these human properties that are at once personal and social bind him to other men in ways that may either foster or restrict his search, discovery, examination, and acceptance of change."
> (Knutson/1965:412-3)

The above author further identifies several routes by which social groups assist individuals in learning situations. They may help identify obstacles, evaluate outcomes, identify issues, and may provide emotional support as well as pledges of future support. (Knutson/1965:413)

Taken in perspective, simulation gaming may be considered one of several problem-solving instruction techniques, along with case study, role playing and others. We should (but cannot here) compare manual simulation gaming not only to computer simulation, but as well to other techniques advanced for enhancing the teaching power and relevance of contemporary educators. One urban planning writer considers simulation gaming as a modification of the case study approach:

> "<Case studies> are unable to reproduce all the emotional resonances central to modern urban tensions, which are appreciable only by contact with real people. Gaming simulations, which for present purposes I would classify as a dynamic version of the case approach, also have enormous potential, although they too suffer from many of the same deficiencies, along with the simplification of assumptions necessary to make them operative."
> (Doebele/1970:271)

The motivational value of problem-solving teaching methods has been treated elsewhere:

> "Cantril <1950> has suggested <that> the process of seeking the solution may be more satisfying than the end goal achieved. He invites attention to the value we place on playing the game, of expressing oneself in creative effort, or of testing oneself in purposive strivings. . . . Thus

> the satisfaction derived from purposive activity in seeking solutions may in itself have motivational value and help to spur the individual on to further explorations and further learnings." (Hadley Cantril, cited in Knutson/1965:412)

Opportunities to test alternate strategies, while maintaining some detatchment from the repercussions accompanying strategic errors in real-life, are readily provided by simulation games. (Tansey and Unwin/1968:2077) Players may pursue clearly outlandish courses and, in some instances, are explicitly encouraged to act on motives not their own. (Gamson/1971) Selection of contrary-valued strategies--and the reactions thereto of game peers and of the game model--can serve to illuminate, for players and game administrators, variations in perception among individuals observing common phenomena. In the course of play, simulation game participants learn the structure of action exemplified by the game model; "the structure of action, once learned, becomes a structure to which relevant information is assimilated." (Coleman/1968b:68)

Simulation games, then, may, as John Dewey observed at the turn of the century, help link students to the world beyond the educational institution. (John Dewey, cited in Boocock/1968:56) Particularly with regard to the complexities of the social order, games may offer "that degree of abstraction from life and simplification of life that allows <the player> to understand better certain fundamentals of social organization." (James Coleman, quoted in Gamson/ 1969a)

Players are not the only beneficiaries in gaming simulation. For example, some of the earliest designers of formal simulation games, describing the experience of the Rand Logistics Systems Laboratory at combining simulation with gaming for long-range logistics planning, pointed out that their endeavor "forced the specification of many elements that hitherto had remained vague or abstract and demonstrated many of the problems that might be encountered in real-world implementation." (Raimer and Steger/1961:7-8)

BUT ARE THEY REALLY LEARNING ANYTHING?

What of the claims of actual learning made for simulation games? Most of these devices have been developed for secondary school audiences. For secondary school teachers as well as students "the rapidity of social change induces an uncertainty about what skills will be relevant <to the future>." In many instances "the child is being taught for a future whose needs have not yet impressed themselves upon him." (Boocock and Coleman/1966:217) Many game designers consider it part of their task to rescue students from outlooks reflecting considerable alienation from and frustration with contemporary change mechanisms. Some have focused on populations whose perception of causation (control beliefs) reflect a felt inadequacy to affect the courses of their lives.

> "Little is known about the methods to increase control beliefs. One possibility would be to let the actor experience situations which are sufficiently simple so that outcomes and environmental states are clearly contingent on his own behavior, and which at the same time are sufficiently similar to real-life situations so that generalization is feasible. Simulation games exemplify such a possibility."
> (Schild/1968a:101-2)

The development of control beliefs carries great significance for all groups contemplating a sharing of control over service and other institutions with lay persons, since "one variable that has been found to be related to participation is confidence that one's efforts will be effective." (Boocock anc Coleman/1966:234)

Much of the evaluative work done on the learning value of simulation games has not been rigorous. Many have been content with the obvious interest shown by students in this medium, and have dismissed the possibility that the Hawthorne (novelty) effect might be a significant influence here--an assumption demanding thoughtful investigation. That students are highly motivated, though, is clear:

> "Anyone who has used <games> in teaching can attest to the excitement and interest they generate. This interest must be channeled in an analytic direction by a skillful instructor if it is ultimately going to lead to learning, but the problem of engagement has been virtually solved from the outset."
>
> (Gamson/1969a:1)

The use of simulation gaming as a catalyst to after-game analysis of the collective game experience, and of relating that experience to real life, has beer ingeniously developed by Gamson in SIMSOC.

> "I think the learning experience is the post-game session, not the game. It's very easy for people to play the game and learn nothing. It generates a tremendous amount of material and makes a lot of things accessible to people, but it still just creates a high potential for learning. The post-game session is what pulls it together. I really see that as absolutely critical . . . . Just like people can learn nothing from experience, they can learn nothing from this experience." (Gamson/1970)

Designers are currently becoming increasingly specific ir their claims for gaming simulations. In a recent article one designer cited: the encouragement of players to use intuitive heuristics, their inducement to perform (if often unwittingly) cost-benefit analyses, their heightened awareness of the nature of stochastic processes, and the carryover into their lives of social skills, such as the ability to persuade or negotiate. (Abt/1968) Authors also cite the possibility of encouraging players to modify games and develop new ones on their own. Shubik writes of this possibility: "It is my belief that game construction offers the most important teaching use of gaming." (1968:644)

V. SIMULATION GAMING FOR RESEARCH PURPOSES

WHAT RESEARCH PURPOSES?

We have already hinted at clinical and research applications in discussing suggested uses for simulation gaming in planning, where the technique may serve operational as well as teaching purposes. Other research areas have been similarly cited as receptive to gaming.

The construction of nongame computer simulation models, the refining of models, and the generation of new hypotheses are all indicated as amenable to contributions from simulation gaming. In "The Systems Approach to the National Health Problem," Horvath (1966:8-392) suggests the use of games for model development:

> "We can . . . attempt a rather crude simulation by trying to identify the major interactions and then formulating a set of rules for a game . . . . Despite the tenuous nature of some of the approximations and the fact that a number of hidden variables do not appear explicitly in this procedure, a good deal of practical insight can be derived from the running of such games. Furthermore, the experience obtained from the first tentative models will frequently result in the introduction of considerable refinement in the later experiments."

Other research uses are also being explored. One area of interest has been that of human decision processes.

"The need for experimentation on human decision-making process is pressing; the number of worth-while topics for investigation is astronomical; and even under the best circumstances the costs are immense."
(Shubik/1968:630)

Other investigators have indicated an interest in utilizing simulation games to assist human behavioral studies generally. Data collection and measurement roles have been suggested. The data collection use may be especially valuable since:

"The reasons people give for their behavior, or for their wants, concerns, or intentions they express cannot safely be taken at face value. Man has a remarkable capacity for concealing from others, and even from himself, the intimate purposes underlying his actions. He may forget, suppress, or repress disturbing fears or socially unacceptable desires. He may rationalize away threatening self-evaluations, or reasons for error, failure, or weakness. He may seek to escape responsibility for motives, feelings, or actions by projecting them on other persons."
(Knutson/1965:217)

Knutson (1965) cites the resulting development of "indirect, nondirective, and projective" techniques to meet the above problem. Simulation gaming can be considered a hybrid falling in this class of techniques. The use of simulation for sociological measurement purposes--"situational response testing"--is detailed by Schalock (1969:9).

LIMITATIONS IN RESEARCH APPLICATIONS

Gamson anticipates problems with using simulation games in classical experimental designs:

> "There are real problems in using this <simulation gaming experience> for systematic research. One difficulty is that there is so much happening at any one time that it is really impossible to watch it all . . . and the efforts that would be involved in building enough control to keep track of it would really get in the way of the teaching value of the game. Another difficulty is that there are so many different variables operating that it is almost impossible, short of running thousands of games, to identify which among the many are affecting the results. I think that if you wanted to use <SIMSOC> for research you would have to control for many of the things that are now left sort of free-floating parameters."
> (Gamson/1971)

Gamson (1971) commented further that he found simulation games "not particularly helpful for hypothesis testing, but useful . . . for hypothesis generating."

Shubik (1968:631) identified another problem in research applications: the high cost of some experimental gaming. "The search for resources," he wrote, "is exemplified in the use of undergraduates, prison inmates, enlisted men, or trapped graduate students as game players . . . ."

VI. ARTIFACTS, CAUTIONS, AND REMEDIES

ARTIFACTS AND CAUTIONS IN EDUCATIONAL APPLICATIONS

Among the artifacts associated with and cautions relevant to educational applications of simulation games are those concerning:

1. Extreme simplification over real-life
2. Difficulty in generalizing game experiences to real-life
3. Game-induced risk-taking
4. Selection of variables
5. Game-induced expediency
6. Creation of myths
7. Contraindicated player populations

Many of the qualities of simulation games that lend the medium much of its power can also serve as liabilities. Simplification artifacts, for example, can be hazardous to researchers as well as to players.

> "The fact of extreme simplification of the situation, of holding other things equal, may produce an effect that confounds . . . the results of the experiment. The 'unreality' of the laboratory, the fact that behavior in the laboratory has no 'real life' consequences, also may vitiate the usefulness of knowledge gained in such 'piecemeal' simulations."
> (Raser/1969:27)

An appreciation for the limitations on real-life choices and consequences, a sense of the underlying order of complex systems and of some effectiveness at controlling the course of one's life (Boocock and Schild/1968) may accompany the player's game experience. These would seem to provide little danger to the player as long as he can generalize his game experience to analogous real-life problems. The player who failed to generalize might well return from the game environment expecting greatly increased predictability of outcomes in matters highly similar to those treated in the game. He might, in this situation, come to feel deceived should his decisions outside the game be the source of unexpectedly unfavorable consequences.

The "game attitude" described previously (Boocock and Schild/1968) may induce players in real-life--given the relative painlessness of errors in games--to risk mistakes unnecessarily. The relatively high speed of feedback possible in games, moreover, frequently finds little parallel in real life. This presents a possible hazard when we consider the impressions shown by many players that their game experience, compressed in time, was highly "realistic."

Numerous artifacts may accompany the selection of simulation variables and the limitations imposed upon them. "The variables embodied in the simulation are likely to be those about which <a designer> knows the most, rather than those he has determined to be most crucial." The impact of this tendency has been considered, but mostly as it relates to research applications. "One advantage of using simulations in research . . . is that if you have neglected important variables, the outcomes of your simulation are apt to be absurd." (Raser/1969:28) The outcomes for players might be a bit less innocuous, in part because a player may not perceive the absurdity as just that, or he may tend to blame himself or other players.

Other designer biases may also enter as a result of his selection and organization of game variables. No matter how the variables are selected, he may encounter some difficulty in developing games "so that no single course of action appears obvious or best for all players." (Gamson/1969a:2) Designer values can be seen to take on particular significance in the opportunity, frequently encouragement, given players to develop a high value on expedience. The game-induced value of expedience, further, is only one of many values that may be manifested in player interaction norms. (Schild/1968a:98)

Shubik (1968:635) cites another potential hazard:

> "There is considerable danger that without due precautions a large scale game (especially if it is computerised) may become a mechanization of popular mythology, adding to it a dollop of scientism."

Additional game artifacts include: the even distribution of resources in many games, the use of fixed rules, the encouragement given for players to tend toward one or the other of the interaction continuum extremes (i.e., pure competition or pure cooperation), and the recognition of clear winners and losers. (Abt/1968:69)

Still other problems are posed by contraindicated player populations, such as sick persons in the recent trials of "Medigame." (Galiher et al/1970:380) Depression and other negative effects were reported by some "Medigame" observers in games run with sick players. Difficulties are also presented by those turned off by games, "who are very negative to the games, who say they disliked a game or would not want to play it again." (Boocock and Coleman/1966:224) In addition, a tendency has been observed for some persons to look upon simulation games as geared explicitly to underachievers. While the motivational effects of games seems highly instructive for this group, it may suggest to some that they facilitate a form of second-class learning. (Coleman/1968a)

REMEDIES IN EDUCATIONAL APPLICATIONS

Many of the previous hazards can be successfully avoided by incorporating into the game experience a debriefing session, during which time insights and issues are examined, matters of game validity are discussed, and game artifacts explored. The session format and contents clearly require thoughtful consideration on the part of the game designer, not just his token suggestion that game administrators pursue such discussion. This will frequently mean, especially when games will be run by inexperienced persons, that the importance of this integrating and cooling-out period must be emphasized, and that appropriate supporting materials must be included. In institutional settings, educators may well enjoy the effective shift of control (back from the game to the instructor) that a post-mortem allows. This point takes on some importance in light of the observation of Boocock and Schild (1968) that teachers may feel threatened by the initial shift of content control from themselves to games.

ARTIFACTS AND CAUTIONS IN RESEARCH APPLICATIONS

Problems are also posed in simulation gaming when serious investigations are performed. These include but are not limited to:

1. The game playing spirit
2. The rhetoric of obvious success
3. Difficulties with classic experimental design
4. Observer variability and game reliability
5. Subject hostility toward gaming
6. Measurment of strategy development
7. Learning effects and other perturbations

One of the assets for players cited earlier now appears as an obstacle for researchers: "It has been argued that too much of the game playing spirit pervades the use of gaming and that it destroys the possibilities for serious analysis." (Shubik/1968:634)

In another game area currently under scrutiny, Davis

(1970) laments the "rhetoric of obvious success" that many game evaluations produce. The situation today, in reality, is not a great deal different from that a few years ago, when Thorelli and Graves (1964) wrote of management games:

> "We know little about the effectiveness of management games as an instrument of instruction. Indeed, we do not even know for sure how to distinguish a good game from a bad one."
> (quoted in Boocock and Schild/1968: 17)

The evaluative efforts undertaken to correct the above situation have frequently encountered problems where attempts are made to use classical experimental design. Control persons must be presented an innovative game (or nongame) alternative, random allocation of groups may not be possible, and it is difficult to present to both groups, experimental and control, the same subject material. (Boocock and Schild/1968)

Evaluations performed with untrained game administrator/observers may show significant observer and debriefing variability. Variability is elsewhere problemsome in confirming external validity of simulations where there has not been established reasonable reliability from one game run to the next. (Coplin/1970) In additior, significant interpretative problems may be posed where evaluations consider subject-matter retention alone as the criterion measure (Young/1969:77), or treat attitude change as sufficient indication of behavioral impact.

Difficulties are also presented in those instances where there exists hostility toward gaming investigations. This reaction, comparable to that hostility directed at game theoretic (mathematical) constructs, may derive from "a distaste for coolness, detatchment, and calculation (all of which are connected with games) as against warm-heartedness, commitment, and intuition." Games, Wohlstetter (1964:221-2) continues, may also suggest "frivolity . . . about serious matters, matters of life and death," and, in the case of military and some other simulations, "sadistic pleasure in calculations about enormously painful and cataclysmic events."

Additional evaluation problems are presented when the measured element is player strategy development. Schild (1968b:151) writes:

> "While games may teach more than winning strategies, the learning of strategies has in a sense priority over other possible learning. It is the most direct outcome of playing a game and thus, I would conjecture, the point where the game is likely to have the strongest impact."

Useful and reliable tests for strategy development have been difficult to devise.

Finally, game runs are often lengthy, learning effects may for some experiments be troublesome, and, more generally, the inclusion of humans in the game environment (by contrast with the opposite tendency in nongame machine simulations) complicates experimental design considerably.

In the next section we will discuss some specific uses to which games have been put for health purposes, as well as for purposes which suggest appropriate health analogies.

VII. HEALTH APPLICATIONS OF SIMULATION GAMING

> "The growth of large-scale enterprises, multi-plant operations, and extensive product diversification has greatly complicated problems of organization, coordination, and communication."
> (Greenlaw et al/1962:2)

Ten years ago a text surveying the state of the art of business simulations gave the above as the crux of the problems motivating the search for new management training techniques, such as those involving simulated environments. Today the health care systems of several industrialized nations have many of these problems in common with large-scale business enterprises.

Health services are rendered through a variety of discrete facilities (analogous to multi-plant operations). Services delivered have shown tremendous diversification as delivery style has evolved from that of single-server (GP) practices to multiple-server medical groups. Such trends have indeed been accompanied (again in agreement with the analogy) by increasingly complicated problems of organization, coordination, and communication.

AN EARLY HEALTH APPLICATION

While health matters have come under increasing scrutiny from operations researchers, only a few researchers have demonstrated an interest in simulation gaming for educational and research purposes in public health. Bogandoff (1963:4-5) performed elaborate public health simulation games with the Systems Simulation Research Laboratory of the System Development Corporation. He argued for the necessity of his game model being comprehensive in scope:

> "Outside a laboratory setting, disease does not occur in a vacuum, but in a human ecological framework and has meaning only within this ecology; therefore, any gaming condition between the system of public health administration and disease attacks on human communities must involve the replication of an environment at a scale of simulation seldom found in gaming procedures . . . . Thus, we became involved in what we have termed the 'simulation of a total environment.'"

His contention that a <u>total</u> environment simulation is required is shared today by several computer simulation practitioners, who have deemed this end intractible and have therefore avoided broad health care model design efforts.

Bogandoff's game description centered on a multiperson model of the environment of public health agency administrators, in which several persons role-played environmental components (both inside and outside the health agency) under a simulation supervisor. Three players, external to this group of subsystems simulators, sought to alter the course of a "stylized epidemic" created by the game model designers. An "event mapping" procedure was employed whereby the course of the epidemic in the absence of player intervention was plotted, subject to adjustment only if intervention was attempted by players. Bogandoff cited possible personnel training, systems analysis, and research applications.

Considerable public health intelligence was clearly required by the human simulator components in order that responses to player actions approximated real-life responses, which could reduce the utility of this sort of game for use by untrained game administrators (if it did not prohibit it altogether).

DISCUSSION AND SPECULATION ON HEALTH APPLICATIONS

Relatively large-scale health care delivery simulation games, analogous to those developed for business education purposes, have been discussed by Flagle (1966) and Horvath (1966). Flagle (1970:2386) illuminates an especially significant factor in choosing simulation techniques over others for studying potential health system innovations:

> "The real world can be a costly place to operate on a trial-and-error basis, even with small scale or pilot efforts. Failures are there for all to see and <are> not easy to forget. The disruption of innovation is damaging to morale unless a beneficial change is apparent."

Flagle describes further the tendency for operations researchers to choose to model relatively small health system subunits, and attributes the reluctance to attempt large-scale public health simulatiors in part to the realization that on this broader level "the problems and the authority to make decisions are diffuse." (1970:2393)

Horvath (1966:B-393) suggests simulation gaming as suitable for gaining insights into medical care costs, governmental actions and consequences, the impact of different training styles on medical personnel, alternatives to hospitalization, as well as into the problems associated with more traditional public health areas. He suggests performance criteria which include minimization of work disability days, of the income segment spent on health needs, and of patient visits per doctor. He indicates his objectives in gaming as the encouragement of operational economy and the more beneficial assimilation of technological innovations in the health sector.

RECENT HEALTH APPLICATIONS

Perhaps because the results of many simulation gaming efforts have not been published in widely disseminated journals (Berger et al/1970), this writer was able to locate only a few simulation games developed for health purposes. Among them are Bryant's "Rural Health Care Game" (Christian Medical Commission/1970), a health task allocation game; the American Board of Orthopedic Surgery's "Patient Management simulation", a testing device; Belkin's "The Fate of Our Food" (1968), discussed earlier; Lockheed Educational Systems Organization's "Drug Attack" (1969); Abt's "Pollution" (1970); Galiher's "Medigame" (1970), which teaches effective

Medicare utilization to the elderly; "Baldicer" (1970), a world food distribution game; and "Cooperation and Conflict" (1970), a health planning game developed at the Institute for the Study of Health and Society (Grogan et al/1970). Harrington (1966:150) mentions a simulation game then in use at the Communicable Disease Center (USPHS) in Atlanta for training public health professionals. A dental emergency simulation game was recently described by the Teaching Research unit of the Oregon State System of Higher Education. Schools of public health, in addition, are likely to be working with this medium, although little mention has been made to date in the literature.

The simulation game structure developed by this writer combines elements of Bogandoff's, Flagle's and Horvath's constructs. The section which follows describes the development of a health maintenance game structure. Playing instructions and game hardware are not included. These will be available from the author when further efforts at development and revision are completed.

VIII. HEALTH MAINTENANCE GAME STRUCTURE

BACKGROUND

One seemingly difficult concept for a health educator to get across to certain planning (and many consumer) audiences is an appreciation for health threats posed by a hostile environment, which factors are significant to the health of at-risk populations (at times quite independent of manifestations in discomfort or disability). The sheer number of threats of interest to educators, let alone the details on the etiology of each, could make individual discussion of health threats tend toward tedium at best; the situation might serve to instill a sense of fatalism or denial most unconducive to sound preventive care-seeking behavior, as well as unconducive to early diagnosis and treatment of manifested conditions.

One approach to resolving this dilemma might first involve, for diminished complexity, the reduction of health threats to a few seemingly crucial behavioral variables. Let us adopt three common ones: felt susceptibility to a threat, felt threat severity, and felt amenability of a threat to preventive procedures or of its manifestation to curative procedures. (Hochbaum/1970) We then outline an artificial health care environment, highly simplified relative to real life, but comparable nevertheless. Let us place in this environment simulated persons at risk of fictitious health threats--threats whose specificity for age group, sex, and other demographic parameters is predetermined by the environmental designer. We now bring a set of players (to manage the health care of the simulated persons) into the simulated health-hostile environment and "turn it on." Thereafter we shall alternate between player decisions and environmental responses, new decisions and new responses.

We improve upon the environmental realism, with some increase in complexity, by placing these real individuals (players) in positions such that each player is presented with an environment which includes: all the other players, the game components, and game rules. The inclusion of real players in the individual's game environment should (here) enable the game to operate independent of supporting machinery and of intelligence external to the game players, rules, and game administrator.

It would be highly tempting to structure actions and responses so as to allow rewards for health-benefitting behavior only. However we would then forego the opportunity for players to gain many insights into real-life problems, where much behavior is rewarded that is <u>not</u> conducive to good health. The text below will elaborate on the health maintenance game structure.

GAME STRUCTURE OVERVIEW

The health maintenance game structure is a "bare-bones" model of some aspects of health care systems. It focuses on the problem of decision-making in situations where resources are limited, and where human suffering will rise or fall in response to player decisions and nature's decisions (and due to human indecision). In one sense this game may be considered a "game against nature," for she is the common competitor for all players.

Players in this simulation game make decisions on how to allocate scarce resources to "best" advantage, whether to take preventive or curative measures in response to health threats or disease acquisition, how many "persons" to include in their catchment (service) areas, which if any clients to refer elsewhere, and they decide other matters as well.

Player actions of course apply only to simulated clients living in a simulated environment. Clients are at risk of acquiring one or more of several fictitious diseases. The physical correlate of simulated persons in the game is trivial. People are represented by circles, catchment areas by striped triangles. Spaces between stripes represent "zones of health threat severity", with severity increasing as one approaches the peak of the triangle. Data tables for the fictitious health threats (e.g., diseases, accidents) provide players with information on which to base some of their treatment/nontreatment decisions. Probabilities in the tables are applied to individuals in the population at risk through the use of a random number generator (spinner) divided into twenty equal segments.

Players are allowed to make moves (take actions) whenever the pointer on a simulated time clock is advanced to a new time, except when that new time corresponds to the end of a quarter (at which time players take a break while the national budget is revised).

A table of allowable actions appears below. Note that a player may take only one type of actions while the clock hand is at one particular time. But the player may take as many actions of the type selected at that simulated clock time until the resource manager (an assistant to the game administrator) decides to terminate activities and select a new event card.

TYPE	ACTION
1	Acquire person
1	Refer person
1	Refuse to accept person
1	Discharge person
1	Present a public notice
1	Buy health examination
2	Buy curative procedure
2	Buy preventive procedure
2	Buy health examination
3	Lobby for change in the portion of the budget assigned to human services
3	Lobby for change in health resources distribution priorities
3	Present public notice
3	Lobby for new voluntary (charity) funds or for increases in current ones
3	Lobby for emergency program funds
3	Lobby for nonemergency special categorical grant funds

TABLE I. TABLE OF ALLOWABLE PLAYER ACTIONS

FIGURE I. <u>Health threat data table for health threat (X).</u> Data herein are sample values giving simulated person susceptibility where (X)-specific preventive procedure has <u>not</u> been administered.

(Severity probabilities expressed in twentieths; treatment cost in simulated money units; transition time in simulated time units.)

	age group (1) [ ] - [ ] yrs.			age group (2) [ ] - [ ] yrs.			age group (3) [ ] - [ ] yrs.			age group (4) [ ] - [ ] yrs.			age group (5) [ ] - [ ] yrs.		
SEVERITY	p(S) upon exam	time units before s=s+1	treatment COST	p(S) upon exam	time units before s=s+1	treatment COST	p(S) upon exam	time units before s=s+1	treatment COST	p(S) upon exam	time units before s=s+1	treatment COST	p(S) upon exam	time units before s=s+1	treatment COST
zero	4	40	—	6	50	—	10	45	—	8	45	—	8	35	—
one	8	2	1	6	3	2	6	3	2	4	4	2	5	2	5
two	5	5	10	5	8	12	2	9	12	4	9	12	3	10	15
three	2	7	100	1	10	25	1	8	25	3	7	25	1	8	150
four	1	15	1000	2	30	800	1	40	800	1	35	800	3	30	1000

At least three players are needed for a game run. All players are equals in the game, except for one selected by the game administrator to be the resource manager. This manager is responsible for distributing funds and patients, as well as serving as arbiter for most disputes (should any occur during the game run).

A game administrator observes the progress of the game, and, on rare occasion, may add unscheduled events to those provided in the course of playing.

INFLUENCE OF OPERATIONS RESEARCH ON DESIGN CONSIDERATIONS

In some respects the development of this health maintenance game structure takes on the characteristics of an operations research effort.

> "The reason for the existence of O.R. is that in decision making, difficulty arises for the decision maker when either the range of choice is overwhelming, or the consequences of a particular decision are obscure or, finally, there is a lack of knowledge about the objectives, or more likely, there are many objectives and they cannot be stated on a common scale of values."
> (Rivett/1968)

The range of player choices in the health maintenance game environment is not "overwhelming," but the consequences for the overall game outcome may well be "obscure" to the player making a single small decision, and there are indeed many objectives operative about which we know little.

In order to narrow the range of player objectives and lend further credence to the game (while better meeting overall game purposes discussed previously), players secretly assume one of several specific goals before the game begins. Goals available for selection are determined by the game administrator to suit his particular application. Typical goals may be "the most healthy community" or "the most persons served" or "the most persons receiving preventive care" or "the least money spent per capita" or "the greatest good for the least advantaged" or "the greatest good for the youngest," etc.

Personal goals are made explicit for another reason also. Since game runs are frequently performed with persons of similar backgrounds, there may develop a tendency toward uniformity in player behavior. In a health maintenance game we might expect that it would be difficult, for example, for collectively-oriented individuals to justify acting out of local rather than societal concern, or for altruistic individuals to act on any but noble motives--unless it were considered part of the game to do so. William Gamson remarks:

> "For a lot of people it's liberating to be able to pursue and act on motives that they tend to treat as illegitimate in real life, and which I think are operating in real society. It makes the game <SIMSOC> more realistic, in a sense, rather than less."
> (Gamson/1970)

There are other reasons for pursuing the model construction in the manner described, in addition to the three common to most O.R. problems cited above. As in many other areas where simulation is selected to facilitate insights, a clean mathematical solution is not available for the problem at hand--matching populations at risk of disease, or already disabled, with health services (given societal values on using resources on non-health as well as on health areas). Using the real world for an experimental proving ground, an alternative, would be neither feasible nor ethical in this example. By unfeasible we mean here that it would cost too much, take too long, and/or lose too many votes.

In our problem, an allocation problem, we are thus unable to perform the "elegant mathematical dances" (Rivett/1968:98) characteristic of many O.R. allocation problems, and we are similarly prevented from performing real-life tests. In addition, we accept at the outset that our model can have at best "transient validity" (Rivett/1968:171), for there will be numerous "solutions" to the basic problem of allocating scarce health resources. To the extent that ours satisfies the requirements of an operations research problem, Rivett's analogy (1968:175) is instructive:

> "An O.R. study is not one in which there is at its conclusion a sudden unveiling of the statue of truth, but rather, is a study during which one is gradually chipping away at the confused complex mass of stone with which one is presented until gradually the bones of the solution emerge."

Fleshing of these bones occurs here, it is hoped, in the postgame session.

The significance of the game designer cannot be overemphasized. Neither can the role of the game administrator, to the extent that he shapes the game environment to his own needs through components under his control and through his occasional interventions during the course of the game. We are presented with the designer's perception of the most significant factors operative in real-life, with his feeling for the interaction of these factors to produce alternate results, and his specification of the degree to which interaction occurs and to which outcomes are influenced. In the health maintenance simulation game structure the game administrator is given control over:

1. The range of personal player objectives available
2. The number of objectives specified by each player
3. The criteria for specifying a winner (if an administrator chooses to have a winner at all)
4. Whether all players select simulated at-risk persons from a common population of from several populations, and the shape of the population(s) with regard to age, sex, income and race
5. Intervention with special events during the course of the game
6. Responsiveness of the national budget and other funding sources to lobbying and to disease incidence
7. Variation of disease severity and course (progression) with age
8. Amenability of each health threat to preventive procedures
9. Length of the game run and number of players
10. Variation of treatment cost with severity

11. Type and number of simulated health threats included in the game
12. Fraction national budget for human services
13. Variation of the personal health care assessment with income

The importance of recognizing and avoiding biases in model construction is emphasized in much operations research literature. "Sometimes the construction of the model may involve a series of guesses as to the underlying structure of cause and effect," Rivett (1968:190) writes, "<but> . . . we have to be very careful not to construct a network of cause and effect that reflects what we wish would happen in a nice tidy world, rather than one which demonstrates how messy reality can be."

We deal here with a "multiple objective" problem, as the game structure explanation will detail. An economy is at stake, persons are at risk, resources spent on health are denied other areas (and the reverse also holds). The optimal mix of optimized single objective-specifying relations is traditionally left for the decision-maker to decide in operations research problems. Transfer of the several individually optimized functions to a common scale is thus done subjectively. (Rivett/1968:192) The subjective transformation occurs here in the aftergame discussion.

We would be remiss to leave untreated a very legitimate criticism of any modelling effort, namely the question of validity. Does the model developed in the health maintenance game structure bear enough similarity to real life to warrant its use as a "bare bones" model of real-life phenomena? Rivett speaks to this question, holding a model good when it "is a simplification that works . . . because what has been omitted is not important and what is retained is." He continues with an explanation of the position of the model designer during the design process. "There is ... a large subjective element in model building, and the operational research worker at the stage of construction of his model is an artist rather than a scientist." (Rivett/ 1968:13)

GAME STRUCTURE DESCRIPTION: Versions I and II

The health maintenance game structure is designed specifically to induce a behavioral set among individual players that is conducive to post-game health issues discourse. A common base of experience is provided in a simulated gaming environment, enabling the discourse afterwards to treat not issues in the abstract but "real" problems encountered in the game run. The game experience should ideally facilitate player insights into:

1. The stochastic nature of disease acquisition and progression
2. The age- and sex-specificity of diseases
3. The variation of disease severity and course (progression) with age
4. The increase in treatment costs with increasingly late treatment
5. The differential perceptions among players of acceptable degree and time length of incapacity

6. The sharpening of competing values in the limit of scarce resources for health purposes
7. The impact of "greatest-good-for-greatest-number" and other philosophies for persons of different sex, race, age, and income
8. The sources of funds for health care and problems different sources present
9. The difficulty in predicting for individuals the tangible benefits of preventive care
10. The health care behavior of other players and of himself

The "stochastic nature of disease acquisition and course" is incorporated into the game through the use of health threat data tables (see Figure I) for each threat, in conjunction with a random number generator. When the subpopulations of the several catchment areas in the game are declared at risk of some health threat, players may immediately determine from the data tables the probability of any member in their catchment area displaying (upon examination) manifestation of the threat at any of four severities. Severities one through four, in order of increasing disability, correspond to a person's ability to perform predisease work activities. At severity one there is no discernible impairment of work, at two a person is only 50% productive, and at severity three and four he is bedridden and nonproductive. The disability, where applicable, becomes irreversible on passing from severity three to four. The time progression of health threats from lower to higher severities is given in the health threat data tables.

Also provided in the health threat data tables is the cost of bringing an individual from severity one or two or three to levels zero, one, and two, respectively. Curative and restorative costs are combined in the figures given for treating severity one, two and three cases. The treatment cost associated with severity four disability is a maintenance cost, due to the irreversibility of the disorder at this severity. A random number generator is used for the physical examination of any simulated person to determine whether the fictitious individual is affected by a threat, and, if so, to what degree of disability.

"Age-specificity of health threats" is indicated by grouping the data for all ages into five sets. Persons in each age group have specific health threat susceptibility values, treatment costs, and disease course characteristics, all of which are indicated in the health threat data tables. Sex-specificity is introduced occasionally through the use of data tables on threats applicable only to males or to females.

The "increase in treatment costs with increasingly late treatment" is given in the health threat data tables. It is normally computed by the administrator prior to the game from a curve drawn in such manner as to increase cost with severity by more than the value expected were the relationship linear. In game version II, real treatment estimates, rather than fictitious costs, are employed.

Player perceptions of "acceptable incapacity over time" will be suggested by the extent of emphasis each places on acquiring preventive care for simulated patients, and by the time lag between recognition of the state of a disabled individual and a player's decision (if any) to treat him. Acceptable incapacity over time is influenced in game version I also by each player's assigned goal, decided in consultation with the game administrator at the beginning of a game run. In version II, players determine their own personal goals and declare them on paper. Version II players may, unlike the practice in game version I, elect to change their personal goals during the course of the game.

"The sharpening of competing values, in the limit of scarce resources for health purposes" is encouraged by making resources truly scarce relative to anticipated disease incidence, and by allowing for player lobbying at the regional (resource manager) and national (game administrator) levels. Resources here include time--manifested as the restriction on each player to one type of actions in Table I at any given time--as well as money. Players are also free to persuade one another to formalize group values or otherwise structure the behavior of individual players, barring physical coercion, thus adding a normative or cultural dimension.

A simulated game population is selected by specifying the catchment population composition on variables sex, age, race and income. Characteristics of individuals in the game population may be assigned through the use of random number generators incorporated in a simple computer algorithm, or may be calculated by hand. The population variables are set in such manner as to encourage players to test the impact, on the health of simulated persons, of the treatment philosophies engendered in their individual objectives. Some populations may correspond to real-life ones. However, demographic variables are completely independent when patient characteristics are generated, a clear departure from reality slated for alteration in a future game version.

Sources of funds are identical for game versions I and II. Funding is updated at quarterly intervals in accordance with the disability record of the patient subpopulations and with lobbying efforts, as well as with funds derived from categorical appropriations, block per capita grants, contributions from health voluntaries, and from a graduated personal income assessment. The problems each source can present are illuminated primarily through developments indicated on event cards, which are completed by the administrator prior to the game. The relative scarcity of funds should catalyze lobbying efforts and other symptoms of unmet health needs. These may properly include indignation, despair, and appeals to higher instincts, among others.

The difficulty in predicting for individuals the tangible benefits of preventive care is reduced by providing two data tables for each health threat, one for persons examined with prior preventive procedures, and one for those without such. Efficacy and innocuousness of the preventive procedures are reflected in the table values for the "with preventive procedure" tables. In addition, allowance is made for the development of new preventive procedures. In the latter instance an event card specifying time of availability is required, along with a revised "with preventive procedure" health threat data table for the threat of interest.

Insights into "the health care behavior of others and of oneself" are expected, and provision for developing these into a purposive discourse is made through the post-game discussion. Emphasis is placed on the use of this period for firming up insights gained in the course of the game as well as for exploring new areas touched only superficially in the simulation.

IX. CONCLUSIONS

Limitations on time, plus close attention to artifacts in the health maintenance game structure, has kept the game model in a state of continual modification. It has yet to be completed and tested.

One of the artifacts meriting consideration in this game is the absence of severity transition probabilities. Transition between severity states is deterministic in this model. Other important artifacts include those below. No allowance is made for disease remission. Treatment response time is ignored altogether. Innocuousness of preventive procedures is not clearly distinguishable to players. As mentioned earlier, characteristics of simulated individuals were assumed to be independent upon assignment. No allowance was made for simulated individuals changing age or income groups. These and other artifacts devolve in part from bookkeeping constraints imposed upon noncomputer simulations. It is likely that several of these artifacts could be attenuated or eliminated through computer-assisted bookkeeping and report-generating procedures.

The outlook for simulation gaming in health planning and consumer health education seems considerably brighter than the above problems with this particular game would suggest. The experience of the Institute for the Study of Health and

Society in developing "Cooperation and Conflict" reinforces Shubik's contention that much may be learned by students and others during game construction and modification. This, in fact, may be the gaming area most promising for CHP trainees. 'Forcing specification of systems elements and interrelationships otherwise vague or abstract' is a significant benefit reasonably anticipated of various game construction efforts. In consideration of the above, it would seem advisable to spend sufficient time during game development insuring that game administrators and players alike can modify a health game for subsequent runs. Where insuring game model flexibility incurs significant complexity--as in the health maintenance game structure--it may prove valuable to provide game players and administrators with standard game options as well as with instructions for adapting the structure and variable values to serve user-specified purposes.

The effect of removing some control over future game contents and dynamics from the designer, and vesting it as indicated above, should be that of diminishing the danger of an authoritarian designer's "dollop of scientism," while clearly establishing a strong teaching role for the game administrator. Contributions of computer support to gaming efforts should be scrutinized for possibly unwarranted 'dollop' or 'exclusiveness' ~~or~~ 'sophistication' affect, but may prove useful where model complexity is overwhelming or bookkeeping tasks are too cumbersome.

Prospects are good also due to the general trend of some of public health, medical, and nursing education away from the didactic. As an adjunct to the community involvement increasingly demanded of and by students, simulation gaming in health areas may serve to prepare students and community people for more viable and productive relationships than might otherwise result. It would seem wise, however, not to attempt to bill simulation gaming as "genuine involvement" or even its facsimile.

Since some concern has been voiced that some games don't teach the One Right Way to Do Things, the departure here from a structure where all the "proper" answers are built in merits discussion. Nearly all game designers are intrigued with the ability of games to motivate individuals. But what of motivation after the player departs the game environment? And what happens once simulation games are commonplace enough that Hawthorne effects are no longer operative? If games become recognized as contrived texts, as reshapen didactic, they are likely to be received the same way those communications forms are presently. Furthermore, simulation games would seem potentially more manipulative if heavily value-laden (e.g., with the Right Answers) than if not.

The use of simulation gaming for research purposes in public health appears to this author most intriguing.

Knowledge, on the part of behavioral scientists, of dimensions such as felt susceptibility to disability, perceived disability severity, and felt amenability to treatment--seems something less than exhaustive. The possibility of employing games for purposes of indirect measurement of values and attitudes bearing upon such health fundamentals as preventive care-seeking behavior seems worth exploring.

The value of interdisciplinary efforts in health gaming pursuits is likely to be great. For this reason, it is fortunate that there are in close proximity schools of public health and "centers of activity in simulation gaming." (see Twelker/1970:10-15 for list of centers)

It has hopefully become abundantly clear in the course of this paper that there is hardly a single constituency served by or participating in comprehensive health planning that would be unlikely to benefit, perhaps significantly, from the general behavioral ends sought by designers of simulation games. Whether health simulation gaming can fulfill the promise claimed for the technique in nonhealth areas is another matter entirely. Unless we adopt a position analogous to that of Joseph Conrad's Winnie--and agree that "life doesn't stand much looking into"--further investigation of applications of simulation gaming in health planning and consumer education, of model validity assessment, of the 'germ of credibility' herein explored, would seem near irresistable.

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